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Electronics/DAQ sub working group request for information

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Introduction to the Electronics/DAQ subWG

Motivations and methods

Bring peoples from different laboratories together to imagine realistic scenarios for the readout electronics and DAQ system of the future EIC experiments

Strong links to build with:

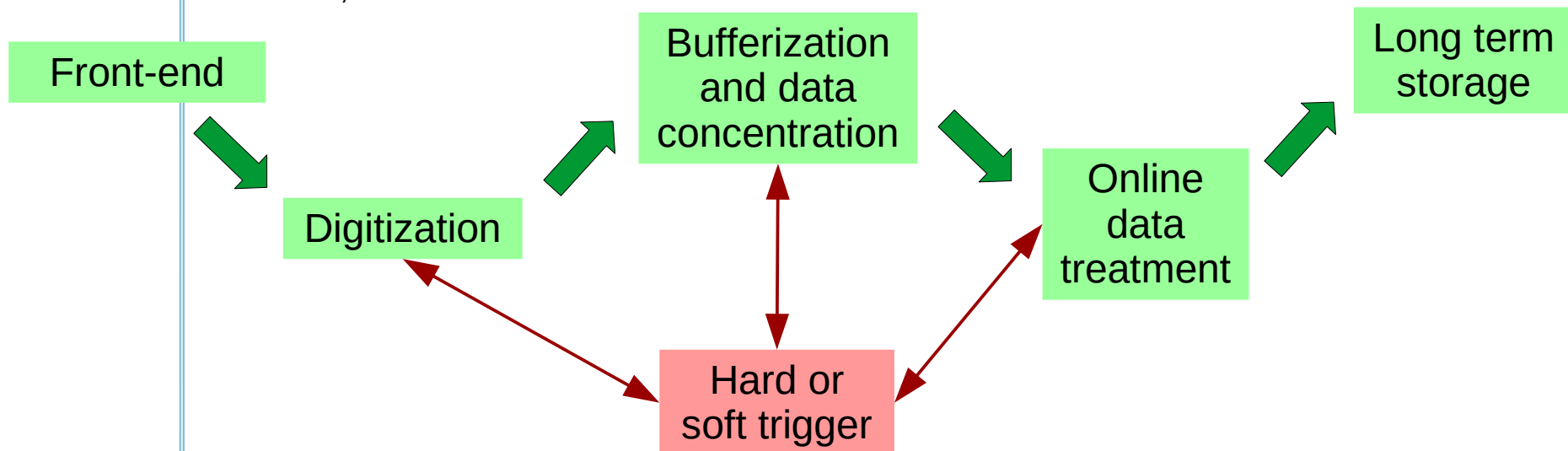
- detector WG → What detector we will have to read ? Expected signal flux ?
- physics and software WG → What signal to read ? What background to reject ?
Which rate for each ? What data treatment to do online ?

12 to 18 months to produce ~15 pages for the yellow report

WG coverage

Front-end/digitization: kind of front-end, expected data rate, constraints on digitization

Data concentration / data treatment: DAQ structure (triggerless, software trigger, etc...), online data reduction or selection, online detector calibration, automatic quality checks, etc...



Issues on front-end

Strongly depends of kind of detector to read

Amplitude and shape of the signals, dynamics of the signals, detector capacitance, number of channels

Measurement to be done: amplitude, timing, position (barycenter of channels), etc...

What resolution for each kind of measurement ? What peaking time ? What expected rate per channel ?

What context ? Particle fluxes, electronics occupancy, electronics noise level, also environment (temperature, pressure, radiation level,...)

Hardware aspects

A lot of existing chips: amplifiers/shapers, digitizers, analog and digital buffers,...

Will be obsolete in 10 years, but can be base of development for future EIC read-out

Different choices: new ASICs ? IP in FPGA ? Integrated analog + digital chips ?

Electronics directly integrated into detectors ?

First steps

Overview on kind of detectors to read → inputs from detector WG

Information on experimental conditions (physics and background rates, particle multiplicities, event sizes, etc...)

Summarize state of the art on read-out electronics: existing chips for each kind of detectors, foreseen evolution, projects of future read-out chips

→ 1 page summary for each chip, or electronics integrated in detector

Issues on DAQ and trigger

Strongly depends on the kind of detector to read / physics to measure / background rates.

Some general questions which are being worked on now

- **Structure of the DAQ**
 - Hardware trigger ? (unlikely)
 - Software trigger ?
 - Streaming readout with no trigger at all ?
- **Event definition**
 - Event triggering ? Should we define the events in the DAQ ?
 - Event building ? Should we construct the event objects ?
- **Online data treatment**
 - High level online reconstruction ? Should we drop raw data ?
 - Data selection ? Should we drop not selected data ?
- **Hardware online monitoring**
 - Online detector calibration ? Should we automatize data reconstruction ?
 - Data online quality checks ? Should we monitor the detector behaviors ?
- **Effect on the physics to be measured / strategies to validate the trigger?**
 - How to simulate the system? Ongoing efforts at BNL and JLAB

Needed information for each considered detector

Information about the detector

Kind of detector: gaseous, solid (silicon, other), scintillating (fibers, slabs,...), calorimeters, etc...

Characteristics of the signals: amplitude, capacitance, intrinsic noise,...

Foreseen number of channels, estimation of average and peak rate per channel at nominal EIC conditions

Estimation of background level: physics background, low energy particle radiation,...

Detector read-out

Data to be acquired for each channel: hit time, hit amplitude, digitized waveform,...

If a type of front-end electronics is already considered for the read-out

If a front-end electronics is already integrated in the detector structure (→ specific page to fill)

Environment of electronics: magnetic field, temperature, pressure

Needs about time synchronization, resolution of time synchronization

Online data treatment

Online data control considered to monitor the detector behavior ?

Online detector calibration foreseen by detector groups ?

Early stage of the WG studies → we don't expect precise numbers, but first estimate would be important to start to discuss on possible front-end solutions

Willing to work together with detector WGs on definition of the front-end electronics